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Tactical Control System (TCS)

Software Requirements Specification

Version 1.0.1

Prepared for:

Program Executive Officer, Cruise Missiles Project
and Unmanned Air Vehicles Joint Project

Prepared by:

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1. **This document includes the following STRs:**

STR	Paragraphs Affected
REQDEV0002	Entire Document
REQDEV0003	Entire Document
REQDEV0004	1.1, 3.4.2 deleted
REQDEV0005	3.3.1
REQDEV0006	Table C-1
REQDEV0008	3.5, Table B-4
REQDEV0010	3.2.6.2, 3.2.6.3, 3.2.6.5, 3.5, 3.10.1, Table C-1
REQDEV0012	Entire Document
REQDEV0014	3.5
REQDEV0017	3.2.3, 3.5, Table B-2
SWDEV0001	3.2.3, A.6
SWINT0001	Table C-1
SWINT0011	3.5, Table C-1
SWINT0017	3.2.1, Table C-1
SWINT0019	3.2.5.1, Table C-1
SWINT0020	2.1, 3.2.6.4, 3.2.6.5, 3.2.7, 3.3.1, 3.5, 6.0, Table C-1
SWINT0021	3.5
SWINT0028	3.2.5.2, 3.3.1, Table C-1
SWINT0029	3.2.4, Table C-1
SWINT0036	3.2.6.1, 3.2.6.4, 3.5
SWINT0042	3.2.6.1, 3.2.6.3, 3.5
SWINT0043	3.2.6.1, 3.2.6.5, 3.5
SYSINT0017	3.2.3, Table C-1

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Chapter 1 TCS Overview

1.1 Document Scope

This document is the Software Requirements Specification (SRS) for the Unmanned Aerial Vehicle (UAV) Tactical Control System (TCS). This SRS does not include the requirements for the Datalink Command Module (DCM) or the Synthetic Aperture Radar (SAR) Processor components of TCS; the interface between TCS and the DCM and the interface between TCS and the SAR Processor are considered external interfaces for the purposes of this document. The Operational Requirements Document (ORD) for the UAV TCS specifies, as listed in Section 1.2, five (5) levels of UAV interaction for TCS. This SRS is written specifically for TCS interaction Level One, the receipt and transmission of secondary imagery and/or data, and interaction Level Two, the direct receipt of imagery and/or data. These efforts will culminate in the development of TCS Software Build 1.0.1.

TCS Software development will be accomplished in an incremental manner. Table C-1 in Appendix C defines when and if a software requirement will be supported by TCS hardware and software.

1.2 System Overview

The UAV Joint Program Office (JPO) has undertaken development of a TCS for UAVs. TCS will be the interoperable command, control and data receipt, data processing, data export and dissemination platform for all tactical UAVs for the armed services. TCS will provide the foundation for interoperability and commonality for the tactical UAVs by providing the common core software elements that support command, control, and data dissemination.

TCS will control multiple types of UAVs and payloads, each with unique performance characteristics. Additionally, TCS will export/disseminate a wide variety of payload data to service specific Command, Control, Communications, Computers, and Intelligence (C4I) systems. Within TCS, the air vehicle and C4I unique elements will be isolated and integrated via definition of Joint Interoperability Interfaces (JIIs). Isolated portable software modules for unique airborne elements will allow for integration of various air vehicle and payload manufacturers' unique components within the common operating environment. By having common core software, isolated unique airborne elements, and JIIs, the TCS software can be ported to any number of hardware configurations currently used by the services. The service will define the desired level of TCS functionality, the battlefield connectivity, and the air vehicles and payloads to be used depending upon the development concept and area of operations. This provides for scalable hardware configurations tailored to support the users' needs.

TCS will support five levels of UAV interaction:

a. Level one is the receipt and transmission of secondary imagery and/or data
b. Level two is the direct receipt of imagery and/or data
c. Level three is the control of the UAV payload in addition to direct receipt of imagery/data
d. Level four is control of the UAV, less launch and recovery, plus all the functions of level three
e. Level five is the capability to have full function and control of the UAV from takeoff to landing.

The Predator and the Outrider air vehicles and their current payloads will be the first tactical airborne elements integrated into TCS. Integration of other tactical UAV airborne elements with TCS, as well as receipt of payload data from manned and unmanned reconnaissance vehicles, is planned for the future as part of the overall TCS program.

1.3 Document Overview

This section has been tailored out.

Chapter 2 Referenced Documents

2.1 Government Documents

Downsized Ground Control Station Tactical Communications, Application Programming Interface Version 1.4.0, UAV SIL U.S. Missile Command, Huntsville, Alabama

MIL-STD-2500A Military Standard National Imagery Transmission Format (Version 2.0), 18 June 1993

MIL-STD-498 Software Development and Documentation, 5 Dec 94

Operational Requirements Document for the Unmanned Aerial Vehicle Tactical Control System (Version 5.0), 17 January 1997

Tactical Control System (TCS) System/Subsystem Specification, April 1997 (Draft)

Tactical Control System Segment to Air Vehicle Specific Segment Interface Design Description, 11 November 1996 (Draft)

Tactical Control System (TCS) to Closed Circuit Television (CCTV) System Interface Design Description, 21 October 1996 (Draft)

Tactical Control System (TCS) to Joint Maritime Command Information System (JMCIS) Interface Design Description, 2 December 1996 (Draft)

Tactical Control System (TCS) to Submarine Based Predator Control System (SBPCS) Interface Design Description (Version 1.0 (Draft)), 5 December 1996

Tactical Control System (TCS) to Automated Deep Operations Coordination System (ADOCS) Interface Design Description

Tactical Control System (TCS) to Advanced Field Artillery Tactical Data System (AFATDS) Interface Design Description

Tactical Control System (TCS) to Joint Deployable Intelligence Support System (JDISS) Interface Design Description

Tactical Control System (TCS) to All Source Analysis System (ASAS) Interface Design Description

Tactical Control System (TCS) to Joint Services Imagery Processing System-Navy (JSIPS-N)/Precision Targeting Workstation (PTW) Interface Design Description

Tactical Control System (TCS) to Joint Surveillance and Target Attack Radar System (JSTARS)/Ground Station Module (GSM)/Common Ground Station (CGS) Interface Design Description

Tactical Control System (TCS) to Synthetic Aperture Radar (SAR) Processor Interface Design Description, 4 March 1997 (Draft)

2.2 Non-Government Documents

(None)

Chapter 3 Engineering Requirements

3.1 Required States and Modes

TCS can exist in three states: (1) Startup, (2) Normal Operation and (3) Shutdown. Software requirements for these three states are included in Section 3.2.

Once TCS is established in the Normal Operations State, two modes of operation are available:

1. Payload processing/imagery display and
2. C4I systems interface mode.

Note: States are mutually exclusive; modes are not.

3.2 Capability Requirements

This SRS defines the data groups to be used within TCS. These data groups are distinguished by the use of capital letters and under scores. For example, the AV_EOIR_TELEMETRY data group includes all of the Air Vehicle (AV) and Electro-Optic/Infra-Red (EO/IR) telemetry data items that TCS receives from the DCM. The members of each of these groups can be found in Section 3.5.

The "circled" numbers in the figures of this document are used as connection points that link the functional flow of one figure to subsequent (or previous) figures. For example, the "circled" 1 and 2 of Figure 3-1 are the connection points to Figure 3-2.

The SRS requirement numbers are bracketed and immediately follow the requirements.

Table C-1 defines when and if a requirement will be supported by TCS relative to the Software Build schedule.

3.2.1 Startup and Shutdown

Upon operator command, the TCS software shall be loaded from the mass storage device into memory. [SRS0001]

If the TCS software is successfully loaded, TCS shall commence system operations using the defaults for the state data. (Note: The default values for the state data are defined in Section 3.5.) [SRS0002]

If the load fails during TCS load operation, TCS shall terminate the load operation.

[SRS0003]
Upon operator command, the TCS software shall initiate shutdown. [SRS0004]

3.2.2 AV and Payload Status Information Receipt

TCS shall be capable of receiving a National Imagery Transmission Format (NITF) 2.0 digital format file SECONDARY_SOURCE_NITF_MSG from secondary sources. [SRS0005]

TCS shall be capable of receiving AV and payload telemetry data (a subset of the UAV and EO/IR System Status Messages and the Flight Control (FC) Status Message as shown in Tables B-1, B-2, and B-3 respectively) in accordance with the TCS to SBPCS IDD. [SRS0006]

Figure 3-1 depicts the TCS receive video and telemetry functionality.

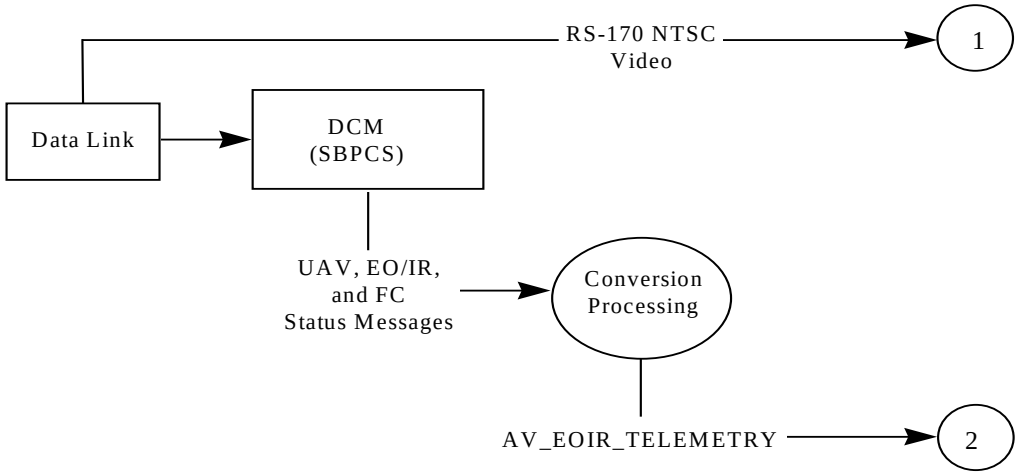

Figure 3-1 Video Image/Telemetry Receive

TCS shall convert the AV and EO/IR telemetry payload data into TCS AV_EOIR_TELEMETRY data. [SRS0007]

TCS shall be capable of receiving RS-170 National Television System Committee (NTSC) video. [SRS0008]

3.2.3 Video Overlay

Upon receipt of new AV_EOIR_TELEMETRY data, TCS shall compute the parameters necessary for overlay AV_EOIR_TELEMETRY_OVERLAY:

1. Convert the GPS_Time_Sec (Current Global Positioning System (GPS) Reference Time, Seconds -- seconds since 00:00:00 Sunday) to GMT_Hr, GMT_Min, GMT_Sec

(Greenwich Mean Time (GMT) -- hours, minutes, seconds). (Note: A.2 contains an algorithm to do this conversion.) [SRS0009]

2. Convert the GPS_Time_Wk (Current GPS Reference Time, Weeks -- week zero begins 00:00:00 Jan 6, 1980) to GMT_Month, GMT_Day, GMT_Year. (Note: A.3 contains an algorithm to do this conversion.) [SRS0010]

3. If AV_Active_Sensor = FLIR (Forward Looking Infra-Red), convert the IR_FOV value to IR_Pyld_Zoom. (Note: A.4 contains an algorithm to do this conversion.) [SRS0011]

Figure 3-2 depicts the TCS video imagery with overlay functionality.

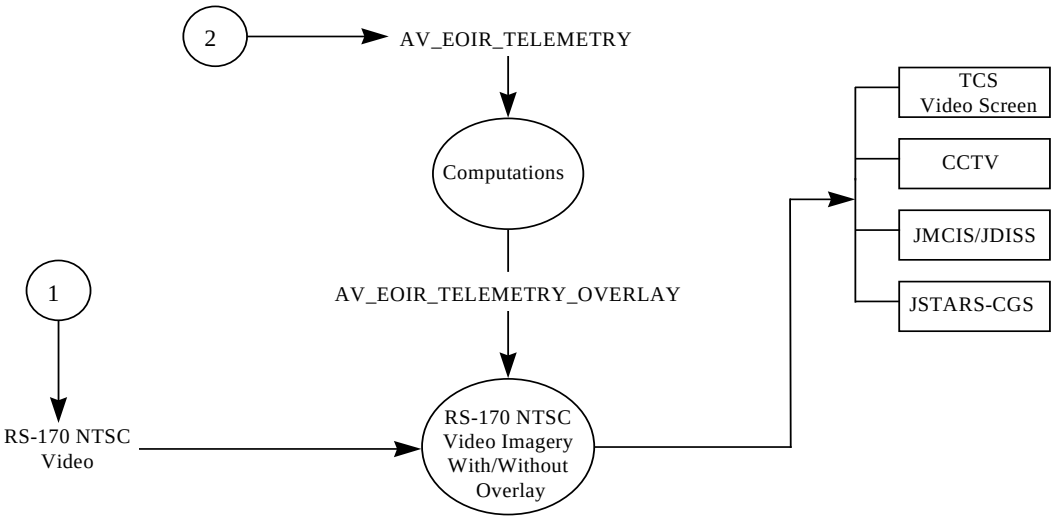

Figure 3-2 Video Imagery with Overlay

Upon receipt of AV_EOIR_TELEMETRY, TCS shall overlay the RS-170 NTSC video with:

1. Cross Hair (Graphic)
2. True North Pointing Arrow (graphic) (Note: A.6 contains an algorithm to determine placement and magnitude.)

and the following AV_EOIR_TELEMETRY_OVERLAY data:

3. GMT_Hr, GMT_Min, GMT_Sec (00:00:00 to 23:59:59 hours:minutes:seconds)
4. GMT_Month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)
5. GMT_Day (1 to 31 days)
6. GMT_Year (1980 to 2099 years)
7. AV_Active_Sensor (Nose Camera 1, EO2 Daylight, FLIR, EO1 Spotter, SAR, Spare, Receiver 3, UAV VCR)
8. If AV_Active_Sensor = FLIR, then
   IR_Pyld_Zoom (19 mm, 38 mm, 70 mm, 140 mm, 280 mm, 560 mm), (Graphic)
   elseif AV_Active_Sensor = EO2 Daylight, then

EO2_Zoom_Setting (0 to 100 percent), (Graphic)
else,
Do not display zoom indicator scale bar,
endif

9. EOIR_Pointing_Azimuth (Ref. to north heading) (-180.00 to 180.00 deg)
10. EOIR_Pointing_Depression (Ref. to aircraft) (-90.00 to 120.00 deg)
11. Payload line-of-sight intercept geographic coordinates (center FOV), Lat/Long, UTM, or MGRS converted from:
    a. EOIR_Fixed_Pt_Lat, Center Point (-90.000_000 to 90.000_000 deg).
    b. EOIR_Fixed_Pt_Long, Center Point (-180.000_000 to 180.000_000 deg).
12. EOIR_Slant_Range (0.0 to 6553.5 nautical miles)
13. AV_Tail_Nbr (1 to 127) [SRS0012]

Upon operator command, TCS shall display (or remove from display) the RS-170 NTSC video imagery with [SRS0013] or without [SRS0014] overlay.

TCS shall textually display the Center Field Of View (FOV) associated with the displayed Sky Ball video, with operator selectable coordinate system (Lat/Long, UTM, or MGRS). [SRS0056]

TCS shall be capable of transmitting the RS-170 NTSC video imagery with [SRS0015] or without [SRS0016] overlay to the Joint Maritime Command Information System (JMCIS) in accordance with the TCS to JMCIS IDD.

TCS shall be capable of transmitting the RS-170 NTSC video imagery with [SRS0017] or without [SRS0018] overlay to Closed Circuit Television (CCTV) in accordance with the TCS to CCTV IDD.

TCS shall be capable of transmitting the RS-170 NTSC video imagery with [SRS0019] or without [SRS0020] overlay to the Joint Surveillance and Target Attack Radar System - Common Ground Station (JSTARS-CGS) in accordance with the TCS to JSTARS/GSM/CGS IDD.

3.2.4 Map and Icon Display

Figure 3-3 depicts the AV icon with text functionality.

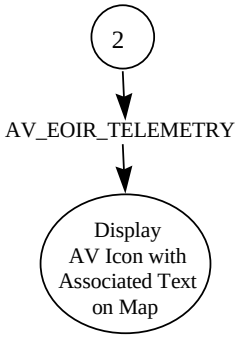

Figure 3-3 AV Icon with Text Display

Upon operator command, TCS shall display (or remove from display) a map, with a north upward orientation. [SRS0021]

TCS shall provide map functionalities (e.g., pan and zoom). [SRS0022]

Whenever the AV position is within the displayed area of the map, TCS shall display an AV icon on the map, with associated tail number, indicating AV position and true heading using AV_EOIR_TELEMETRY. [SRS0023]

TCS shall textually display the AV position, with operator selectable coordinate system (latitude/longitude, UTM, or MGRS)), airspeed, altitude, and true heading using AV_EOIR_TELEMETRY. [SRS0024]

3.2.5 NITF Message Generation

This section describes the data capture and message formatting requirements for generation of NITF messages.

3.2.5.1 Video Image/Telemetry Snapshot Capture

Figure 3-4 depicts the video snapshot capture functionality.

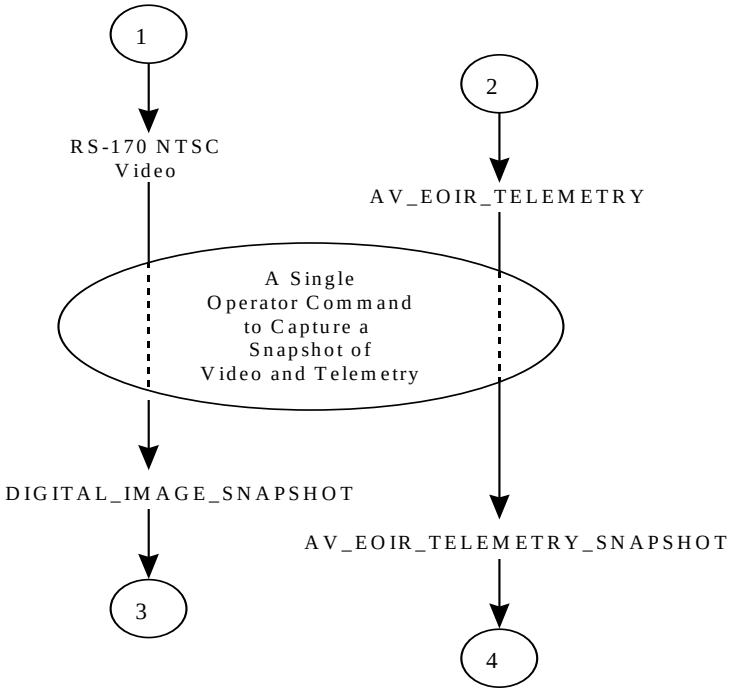

Figure 3-4 Video Image/Telemetry Capture

Upon (a single) operator command, up to once per second, TCS shall:

1. capture and digitize a snapshot DIGITAL_IMAGE_SNAPSHOT of the RS-170 NTSC video imagery [SRS0025]; and

2. capture a snapshot AV_EOIR_TELEMETRY_SNAPSHOT of AV_EOIR_TELEMETRY associated with the DIGITAL_IMAGE_SNAPSHOT. [SRS0026]

3.2.5.2 SAR Image/Telemetry Snapshot Capture

Upon operator command, TCS shall open a UNIX Window, log onto SAR Processor, and launch SAR Processing. [SRS0057]

The TCS operator shall use SAR Processor windowing functionality to capture SAR imagery and telemetry data (see Table B-5), generate a NITF_WITH_TEXT_MSG, and copy the NITF_WITH_TEXT_MSG to a TCS local directory. [SRS0058]

3.2.5.3 NITF Message

Figure 3-5 depicts the TCS NITF message functionality.

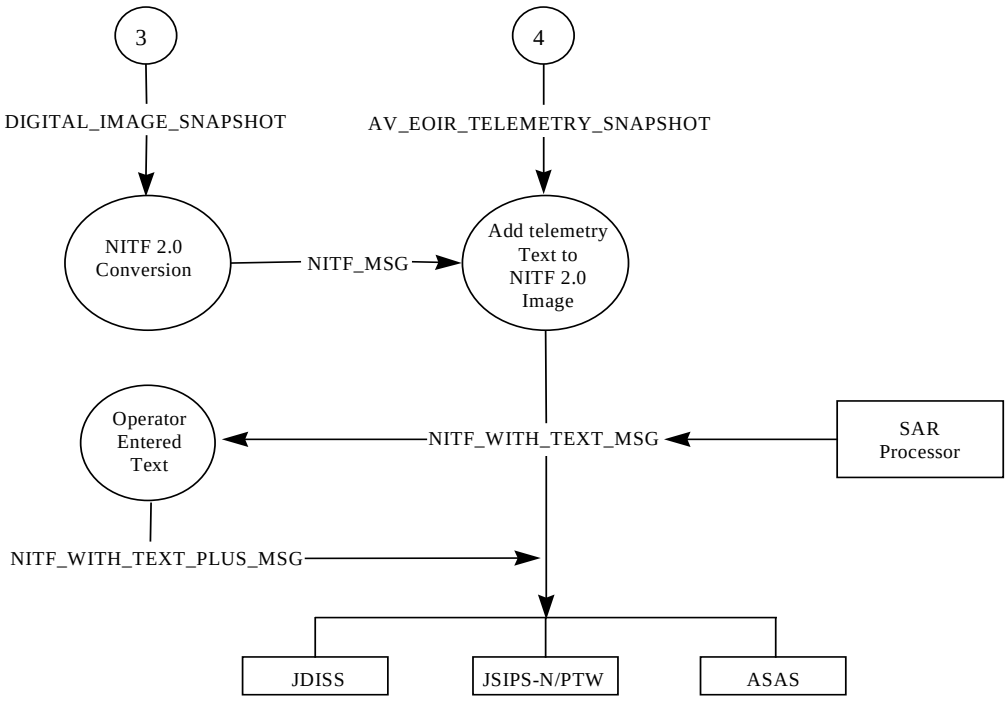

Figure 3-5 TCS NITF Message

Upon operator command, TCS shall convert the DIGITAL_IMAGE_SNAPSHOT to NITF 2.0 digital format NITF_MSG. [SRS0027]

TCS shall incorporate an ASCII text copy of the AV_EOIR_TELEMETRY_SNAPSHOT with the NITF_MSG to create the NITF message with text NITF_WITH_TEXT_MSG. [SRS0028]

Upon operator command, TCS shall incorporate operator entered ASCII text with the NITF_WITH_TEXT_MSG to create the NITF message NITF_WITH_TEXT_PLUS_MSG. [SRS0029]

Upon operator command, TCS shall transmit the NITF_WITH_TEXT_MSG or the NITF_WITH_TEXT_PLUS_MSG to the Joint Deployable Intelligence Support System (JDISS) in accordance with the TCS to JDISS IDD. [SRS0031]

Upon operator command, TCS shall transmit the NITF_WITH_TEXT_MSG or the NITF_WITH_TEXT_PLUS_MSG to the Joint Services Imagery Processing System - Navy / Precision Targeting Workstation (JSIPS-N/PTW) in accordance with the TCS to JSIPS-N/PTW IDD. [SRS0033]

Upon operator command, TCS shall transmit the NITF_WITH_TEXT_MSG or the NITF_WITH_TEXT_PLUS_MSG to the All Source Analysis System (ASAS) in accordance with the TCS to ASAS IDD. [SRS0055]

Figure 3-6 depicts the Secondary Source NITF message functionality.

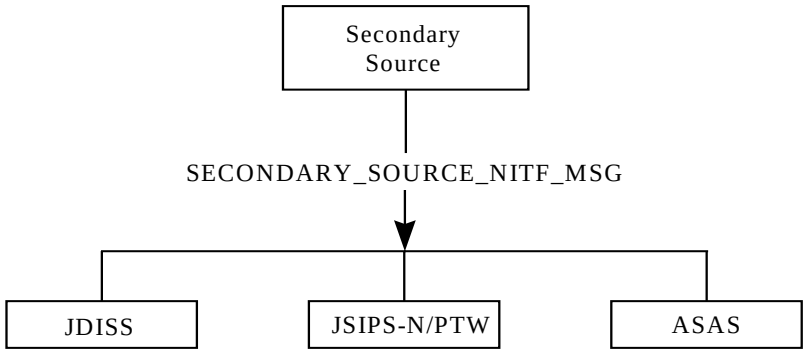

Figure 3-6 Secondary Source NITF Message

Upon operator command, TCS shall transmit the SECONDARY_SOURCE_NITF_MSG to JDISS in accordance with the TCS to JDISS IDD. [SRS0030]

Upon operator command, TCS shall transmit the SECONDARY_SOURCE_NITF_MSG to JSIPS-N/PTW in accordance with the TCS to JSIPS-N/PTW IDD. [SRS0032]

Upon operator command, TCS shall transmit the SECONDARY_SOURCE_NITF_MSG to ASAS in accordance with the TCS to ASAS IDD. [SRS0060]

3.2.6 TACCOM Messages

This section describes the data capture and message formatting requirements for each of the tactical communications messages sent to an external tactical system via the Application Programming Interface (API) described in the Downsized Ground Control Station Tactical Communications, API Version 1.4.0, UAV SIL U.S. Missile Command, Huntsville, Alabama.

3.2.6.1 Targeting Data Capture

Upon operator command, TCS shall capture the TARGETING_DATA from the AV_EOIR_TELEMETRY; the date and time associated with the TARGETING_DATA is converted from the GPS_Time_Wk (weeks -- week zero is Jan. 6, 1980) and the GPS_Time_Sec (seconds -- seconds since 00:00:00 Sunday) to GMT_Day, GMT_Hr, GMT_Min (Greenwich Mean Time -- days, hour, minutes). (Note: A.2 and A.3 contain algorithms to do these conversions.) [SRS0034]

Figure 3-7 depicts the targeting data capture functionality.

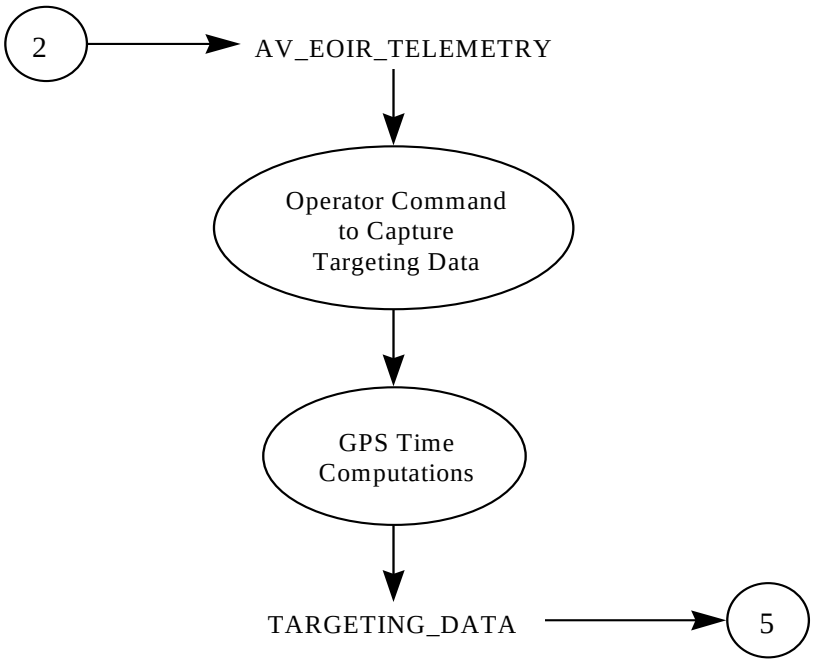

Figure 3-7 Targeting Data Capture

3.2.6.2 TACCOM Configuration File

TCS shall be capable of reading the TACCOM_CONFIG_FILE used to establish Tactical Communication (TACCOM) configuration parameters for a session/exercise. [SRS0035]

3.2.6.3 RECCEXREP Message

Figure 3-8 depicts the Reconnaissance Exploitation Report (RECCEXREP) message functionality.

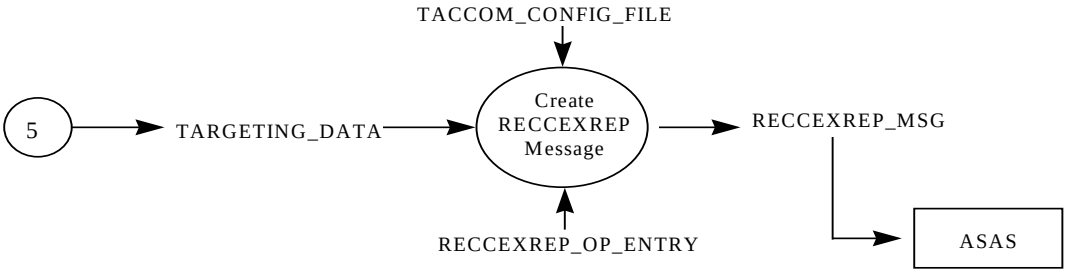

Figure 3-8 RECCEXREP Message

For RECCEXREP, TCS shall display the TARGETING_DATA with an operator option for manually entering or revising the TARGETING_DATA. [SRS0036]

The operator shall be able to enter RECCEXREP data RECCEXREP_OP_ENTRY. [SRS0037]

Upon operator command, TCS shall create a RECCEXREP tactical message RECCEXREP_MSG based on TARGETING_DATA and RECCEXREP_OP_ENTRY. [SRS0038]

Upon operator command, TCS shall transmit the RECCEXREP_MSG to ASAS in accordance with the TCS to ASAS IDD. [SRS0039]

3.2.6.4 SALUTE Message

For SALUTE, TCS shall display the TARGETING_DATA with an operator option for manually entering or revising the TARGETING_DATA. [SRS0051]

The operator shall be able to enter SALUTE data SALUTE_OP_ENTRY. [SRS0052]

Upon operator command, TCS shall create a SALUTE tactical message SALUTE_MSG based on TARGETING_DATA and SALUTE_OP_ENTRY. [SRS0053]

Upon operator command, TCS shall transmit the SALUTE_MSG to the ASAS in accordance with the TCS to ASAS IDD. [SRS0054]

Figure 3-9 depicts the Size, Activity, Location, Unit, Time, and Equipment Report (SALUTE) message functionality.

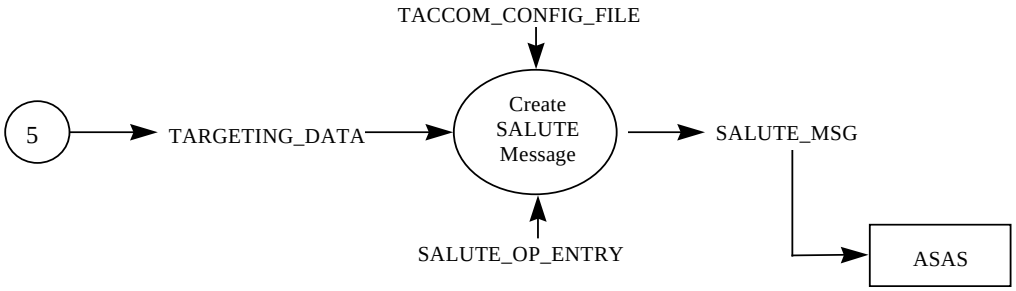

Figure 3-9 SALUTE Message

3.2.6.5 ATI;CDR Message

Figure 3-10 depicts the Artillery Target Intelligence; Coordinate Report (ATI;CDR) message functionality.

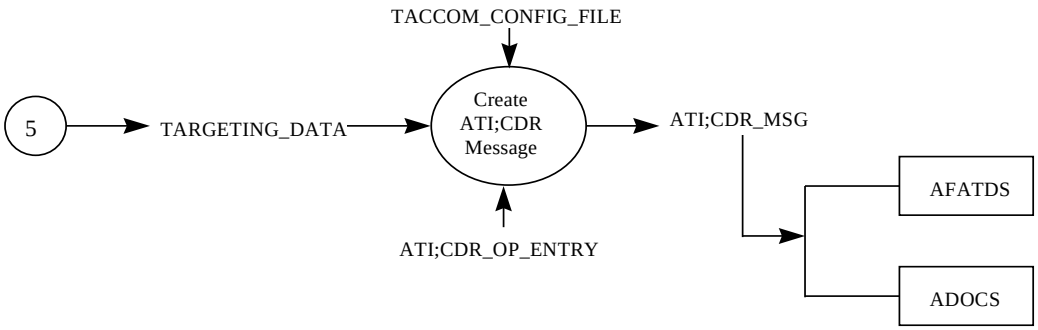

Figure 3-10 ATI;CDR Message

For ATI;CDR, TCS shall display the TARGETING_DATA with an operator option for manually entering or revising the TARGETING_DATA. [SRS0040]

The operator shall be able to enter ATI;CDR data ATI;CDR_OP_ENTRY. [SRS0041]

Upon operator command, TCS shall create an ATI;CDR tactical message ATI;CDR_MSG based on TARGETING_DATA and ATI;CDR_OP_ENTRY. [SRS0042]

Upon operator command, TCS shall transmit the ATI;CDR_MSG to the Automated Deep Operations Coordination System (ADOCS) in accordance with the TCS to ADOCS IDD. [SRS0043]

Upon operator command, TCS shall transmit the ATI;CDR_MSG to the Advanced Field Artillery Tactical Data System (AFATDS) in accordance with the TCS to AFATDS IDD. [SRS0044]

Upon transmission of the ATI;CDR_MSG, TCS shall increment, by one (1), the Target_Number. (Note: A.5 contains an algorithm to do this incrementing.) [SRS0045]

Upon assigning (operator entry or incrementing) a new Target_Number, TCS shall save this Target_Number as the new Target_Number default value. [SRS0059]

3.2.7 JSTARS-CGS Message

Figure 3-11 depicts the TCS JSTARS-CGS message functionality.

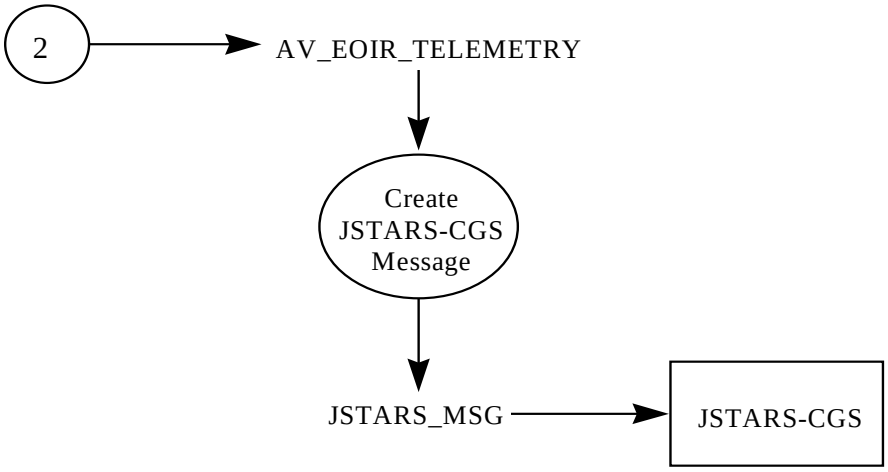

Figure 3-11 JSTARS-CGS Message

Upon receipt of new AV_EOIR_TELEMETRY, TCS shall create a JSTARS-CGS message JSTARS_MSG. (Note: **Message content is TBD.** Associated computations are **TBD**.) [SRS0046]

TCS shall be capable of transmitting the JSTARS_MSG to JSTARS-CGS in accordance with the TCS to JSTARS/GSM/CGS IDD. [SRS0047]

3.3 External Interface Requirements

This section describes the requirements for the external interfaces to TCS.

3.3.1 Interface Identification and Diagrams

Figure 3-12 illustrates the external interfaces for TCS.

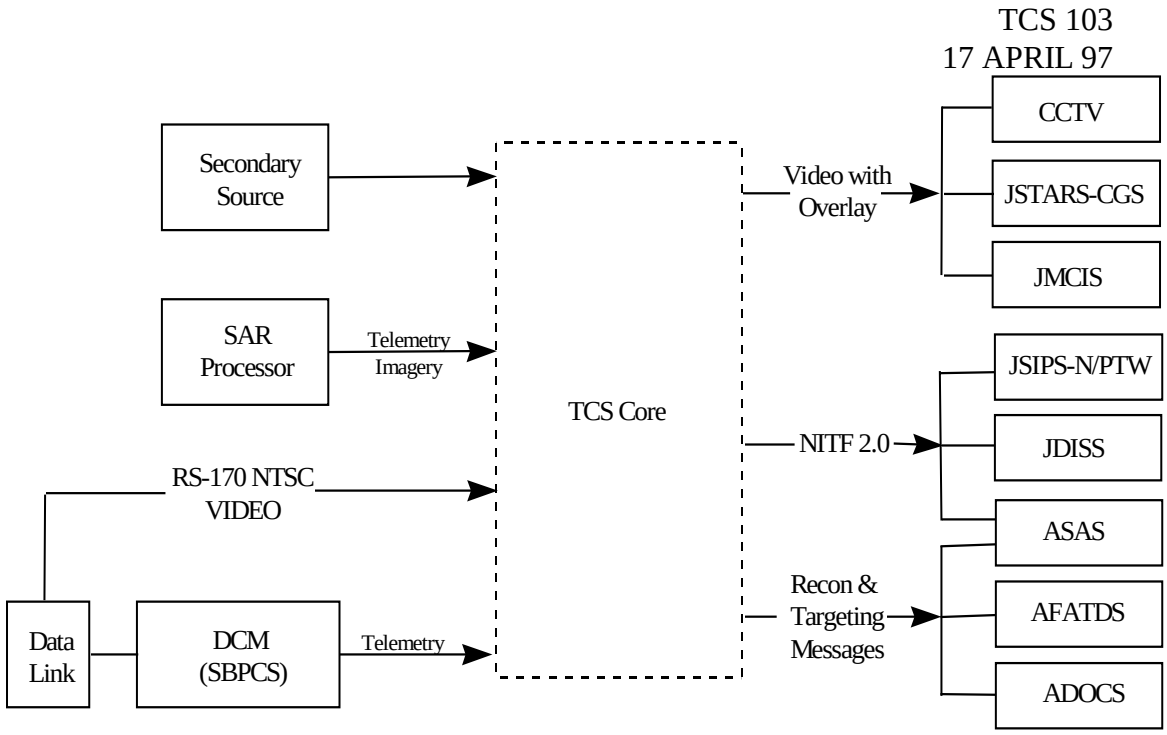

Figure 3-12 External Interfaces

3.3.2 DCM to TCS Interface

TCS will interface with the DCM; this interface is documented in the TCS to DCM IDD, currently titled the Tactical Control System Segment to Air Vehicle Specific Segment Interface Design Description.

Note: TCS will utilize the TCS to SBPCS IDD until Software Build 1.1.

3.3.3 SAR Processor to TCS Interface

TCS will interface with the SAR Processor; this interface is documented in the TCS to SAR Processor IDD.

3.3.4 TCS to ADOCS Interface

TCS will interface with ADOCS; this interface is documented in the TCS to ADOCS IDD.

3.3.5 TCS to AFATDS Interface

TCS will interface with AFATDS; this interface is documented in the TCS to AFATDS IDD.

3.3.6 TCS to ASAS Interface

TCS will interface with ASAS; this interface is documented in the TCS to ASAS IDD.

3.3.7 TCS to CCTV Interface

TCS will interface with CCTV; this interface is documented in the TCS to CCTV System IDD.

3.3.8 TCS to JDISS Interface

TCS will interface with JDISS; this interface is documented in the TCS to JDISS IDD.

3.3.9 TCS to JMCIS Interface

TCS will interface with JMCIS; this interface is documented in the TCS to JMCIS IDD.

3.3.10 TCS to JSTARS-CGS Interface

TCS will interface with JSTARS-CGS; this interface is documented in the TCS to JSTARS/GSM/CGS IDD.

3.3.11 TCS to JSIPS-N/PTW Interface

TCS will interface with JSIPS-N/PTW; this interface is documented in the TCS to JSIPS-N/PTW IDD.

3.4 Internal Interface Requirements

This section describes the requirements, if any, imposed on interfaces internal to TCS.

3.4.1 Interface Identification and Diagrams

These requirements are being left to the design of TCS.

3.5 Internal Data Requirements

Internal data requirements are presented below in alphabetical order.

ATI;CDR_MSG -- This is a standardized message, in accordance with the TCS to AFATDS IDD, containing TARGETING_DATA and ATI;CDR_OP_ENTRY.

ATI;CDR_OP_ENTRY -- This is operator-entered data for the ATI;CDR_MSG. The data to be entered consists of the following:

Target_Number (6 printable characters, where the first two are alphabetic and the last four are numeric; initially the default is XX1000, the current Target_Number is saved as the default value, see requirement SRS0059).
Target_Description (0 to 12 printable characters; default is 0 printable characters)
Target_Type (6 printable characters, see Table B-4 for allowable entries; default is 6 Spaces)
Target_Subtype (6 printable characters, see Table B-4 for allowable entries; default is 6 Spaces)
Target_Location_Error (0 to 10,000 meters; default = 20)
Target_Altitude (-100 to 10,000 meters above sea level; default = 0)
Plain_Text_Message (0 to 15 printable characters; default is 0 printable characters)

AV_EOIR_TELEMETRY -- This information consists of the following:

AV_Tail_Nbr (1 to 127; default = 1)
Mission_ID_Nbr (0 to 255; default = 1)
AV_Position_Source (LN-100G INS/GPS, Trimble GPS, or Calculated; default = LN-100G INS/GPS
AV_Lat_Deg (-90.000_000 to 90.000_000 deg; default = 0.00)
AV_Lon_Deg (-180.000_000 to 180.000_000 deg; default = 0.00)
AV_Alt_Ft_Msl (-3,000 to 60,000 feet; default = 0)
AV_True_Heading (0.00 to 359.99 deg; default = 0.00)
AV_Ground_Track_Deg (0.00 to 359.99 deg; default = 0.00)
AV_Next_Waypoint (1 to 999; default = 1)
AV_Indicated_Airspeed (0 to 255 Knots; default = 0)
GPS_Time_Wk (0 to 2^{31}-1 weeks (week zero is Jan 6, 1980); default = 0)
GPS_Time_Sec (0 to 2^{31}-1 seconds (seconds since 00:00:00 Sunday); default = 0)
AV_Active_Sensor (Nose Camera 1, EO2 Daylight, FLIR, EO1 Spotter, SAR, Spare, Receiver 3, or UAV VCR); default = Nose Camera 1)
EOIR_Pointing_Mode (Position Reference (Heading), Position Fixed, Manual Slew, or Bright Spot; default = Position Reference)
EOIR_Pointing_Azimuth (-180.00 to 180.00 degrees; default = 0.00)
EOIR_Pointing_Depression (-90.000_000 to 120.000_000 degrees; default = 0.00)
EOIR_Fixed_Pt_Lat (-90.000_000 to 90.000_000 degrees; default = 0.00)
EOIR_Fixed_Pt_Long (-180.000_000 to 180.000_000 degrees; default = 0.00)
EO2_Zoom_Setting (0 to 100 percent; default = 0)
IR_FOV (14, 27, 54, 109, 193, or 386 “degrees X 10”; default = 14)
EOIR_Target_LOS_Distance (0.0 to 6553.5 nautical miles; default = 0.0)
AV_Roll_Angle (-60.00 to 60.00 degrees; default = 0.00)

AV_Pitch_Angle (-60.00 to 60.00 degrees; default = 0.00)
AV_Yaw_Rate (-30.00 to 30.00 degrees per second; default = 0.00)
AV_Vertical_Speed (-3000 to 3000 feet per minute; default = 0)
AV_Normal_Accel (-5.08 to 5.08 g; default = 0.00)

AV_EOIR_TELEMETRY_OVERLAY -- This information consists of the following:
GMT_Hr (0 to 23 hours; default = 0)
GMT_Min (0 to 59 minutes; default = 0)
GMT_Sec (0 to 59 seconds; default = 0)
GMT_Month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec; default = Jan)
GMT_Day (1 to 31 days; default = 6)
GMT_Year (1980 to 2099 years; default = 1980)
AV_Active_Sensor (Nose Camera 1, EO 2 - Daylight, FLIR, EO 1 - Spotter, SAR, Spare, Receiver 3, UAV VCR; default = Nose Camera 1)
IR_Pyld_Zoom (19 mm, 38 mm, 70 mm, 140 mm, 280 mm, 560 mm; default = 560)
EO2_Zoom_Setting (0 to 100 percent; default = 0)
EOIR_Pointing_Azimuth (Ref. to north heading) (-180.00 to 180.00 deg; default = 0.00)
EOIR_Pointing_Depression (Ref. to aircraft) (-90.00 to 120.00 deg; default = 0.00)
EOIR_Fixed_Pt_Lat, Center Point (-90.000_000 to 90.000_000 deg; default = 0.00)
EOIR_Fixed_Pt_Long, Center Point (-180.000_000 to 180.000_000 deg; default = 0.00)
EOIR_Slant_Range (EOIR_Slant_Range = EOIR_Target_LOS_Distance from AV_EOIR_TELEMETRY, 0.0 to 6553.5 nautical miles; default = 0.0)
AV_Tail_Nbr (1 to 127; default = 1)

AV_EOIR_TELEMETRY_SNAPSHOT -- This data group is a snapshot of the AV_EOIR_TELEMETRY that is updated along with the video during capture video/telemetry.

DIGITAL_IMAGE_SNAPSHOT -- This is a snapshot of the digital imagery that is updated along with the telemetry during capture video/telemetry.

JSTARS_MSG -- This is a standardized message in accordance with the TCS to JSTARS/GSM/CGS IDD that contains:
AV_Lat_Deg (-90.000_000 to 90.000_000 deg; default = 0.00)
AV_Lon_Deg (-180.000_000 to 180.000_000 deg; default = 0.00)
Time (**TBD**)
TBD

NITF_MSG -- This is a standardized message in accordance with MIL-STD-2500A that contains a DIGITAL_IMAGE_SNAPSHOT.

NITF_WITH_TEXT_MSG -- This is a standardized message in accordance with MIL-STD-2500A that contains a DIGITAL_IMAGE_SNAPSHOT with AV_EOIR_TELEMETRY_SNAPSHOT in text format.

NITF_WITH_TEXT_PLUS_MSG -- This is a standardized message in accordance with MIL-STD-2500A that contains a DIGITAL_IMAGE_SNAPSHOT with or without the AV_EOIR_TELEMETRY_SNAPSHOT in text format and operator entered freetext.

RECCEXREP_MSG -- This is a standardized message, in accordance with the TCS to ASAS IDD, that contains TARGETING_DATA and RECCEXREP_OP_ENTRY.

RECCEXREP_OP_ENTRY -- This is operator-entered data for the RECCEXREP_MSG. The operator is capable of defining up to 20 targets per message. The data to be entered consists of the following:

Message Header (Header information inserted once per message):
- Msg_Class (UNCLASS, UNCLASS EFTO, CONFIDENTIAL, SECRET, or TOP SECRET; default is UNCLASS)
- Msg_Precedence (ROUTINE, PRIORITY, IMMEDIATE, or FLASH; default is ROUTINE)

Number of Target Types (Up to 20 targets per message):
- Number_of_Target_Types (Number of individual targets, 1 to 20; default = 1)

Targeting Data (The targeting data for Number_of_Target_Types individual targets):
- Remarks (0 to 256 printable characters; default is 0 printable characters)
- Target_Activity (Included in the Remarks field as the first “X” number of printable characters: Targets are Stationary, Moving N, Moving NE, Moving E, Moving SE, Moving S, Moving SW, Moving W, or Moving NW; Default is Targets are Stationary)
- Target_Type (Consists of the type of target, FXD WING, ROT WING, SP ARTY, ARTY, TANK, APC, TRUCK, RCKT-MISL, SAM, ADA, BUNKER, INF, or UNK, and how many objects of that type, 1 to 999 (e.g., 1 FXD WING); default is left “blank”)

ATI;CDR Message:
- Send_ATI_Toggle (Yes or No; default = No, Yes is not selectable)

SALUTE_MSG -- This is a standardized message, in accordance with the TCS to ASAS IDD, that contains TARGETING_DATA and SALUTE_OP_ENTRY.

SALUTE_OP_ENTRY -- This is operator-entered data for the SALUTE_MSG. The operator is capable of defining up to 20 targets per SALUTE entry session. Each target is transmitted in separate messages. The data to be entered consists of the following:

Message Header (Header information inserted once per message, up to 20 messages):
- Msg_Class (UNCLASS, UNCLASS EFTO, CONFIDENTIAL, SECRET,

or TOP SECRET; default is UNCLASS)
Msg_Precedence (ROUTINE, PRIORITY, IMMEDIATE, or FLASH; default is ROUTINE)
Number of Target Types (One target per message, up to 20 messages):
Number_of_Target_Types (Number of individual targets, 1 to 20; default = 1)
Targeting Data (The targeting data for Number_of_Target_Types individual targets):
Remarks (0 to 256 printable characters; default is 0 printable characters (Note: One Remarks field for all Number_of_Target_Types individual messages))
Target_Activity (Stationary, Moving N, Moving NE, Moving E, Moving SE, Moving S, Moving SW, Moving W, or Moving NW; Default = Stationary)
Target_Type (FXD WING, ROT WING, SP ARTY, ARTY, TANK, APC, TRUCK, RCKT-MISL, SAM, ADA, BUNKER, INF, or UNK; default is left "blank")
Number_of_Objects (Number of objects of Target_Type, 1 to 999; default = 1)
ATI;CDR Message:
Send_ATI_Toggle (Yes or No; default = No, Yes is not selectable)

SECONDARY_SOURCE_NITF_MSG -- This is a NITF digital data file of unknown content received from a secondary source.

TACCOM_CONFIG_FILE -- This is an editable file that initializes header information used for TACCOM message dissemination..

TARGETING_DATA -- This information is captured from the AV_EOIR_TELEMETRY and consists of the following:

EOIR_Fixed_Pt_Lat, Center Point (-90.000_000 to 90.000_000 deg; default = 0.00)
EOIR_Fixed_Pt_Long, Center Point (-180.000_000 to 180.000_000 deg; default = 0.00)
Time, Greenwich Mean Time (ddhhmmZ, where dd = day of month (1 to 31), hh = hour of day (0 to 23), mm = minute (0 to 59), and Z denotes Zulu time; default = 060000Z)

3.6 Adaptation Requirements

Note: This section should include any installation-dependent data, such as site-dependent latitude and longitude, to be provided by TCS.

This section is not applicable to this document.

3.7 Safety Requirements

Note: This section should include any TCS requirements concerned with preventing or minimizing unintended hazards to personnel, property and the physical environment.

This section is not applicable to this document.

3.8 Security and Privacy Requirements

Note: This section should include any TCS requirements concerned with maintaining security and privacy.

This section is not applicable to this document.

3.9 Environment Requirements

3.9.1 Laboratory Environment

Note: This section should include any TCS requirements concerned with the laboratory environment in which TCS must operate.

No requirements have been identified.

3.9.2 Mobile Test Bed Environment

Note: This section should include any TCS requirements concerned with the Mobile Test Bed environment in which TCS must operate.

No requirements have been identified.

3.9.3 Land-based Environment

Note: This section should include any TCS requirements concerned with the land-based environment in which TCS must operate.

No requirements have been identified.

3.9.4 Shipboard Environment

Note: This section should include any TCS requirements concerned with the shipboard environment in which TCS must operate.

No requirements have been identified.

3.10 Computer Resource Requirements

3.10.1 Computer Hardware Requirements

Note: This section should include any TCS requirements regarding computer hardware that must be used by TCS, including, as applicable, the number of each type of equipment, type, size, capacity, and other required characteristics of processors, memory, input/output devices, auxiliary storage, communications/network equipment, etc.

The TCS software shall be hostable on a Sun SPARC (CHS-2) workstation. [SRS0048]

The TCS software shall be hostable on a Hewlett-Packard TAC-4 workstation. [SRS0049]

3.10.2 Computer Hardware Resource Utilization Requirements

Note: This section should include any TCS requirements regarding TCS's computer hardware resource utilizations, such as maximum allowable use of processor capacity, memory capacity, input/output device capacity, auxiliary storage device capacity, and communications/network equipment capacity.

No requirements have been identified.

3.10.3 Computer Software Requirements

Note: This section should include any TCS requirements regarding software that must be used by, or incorporated into TCS, such as operating systems, database management systems, communications/network software, utility software, input and equipment simulators, test software, and manufacturing software. The correct nomenclature, version, and documentation references of each such software item is also to be provided.

No requirements have been identified.

3.10.4 Computer Communications Requirements

Note: This section should include any additional requirements concerning the computer communications that must be used by TCS, such as geographic locations to be linked; configuration and network topology; transmission techniques; data transfer rates; gateways; required system use times; type and volume of data to be transmitted/received; time boundaries for transmission/reception/response; peak volumes of data; and diagnostic features.

No requirements have been identified.

3.11 Software Quality Factors

Note: This section should include any TCS requirements concerned with software quality factors identified in the contract or derived from a higher level specification. Examples include quantitative requirements regarding TCS functionality (the ability to perform all required functions), reliability (the ability to perform with correct, consistent results), maintainability (the ability to be easily corrected), availability (the ability to be accessed and operated when needed), flexibility (the ability to be easily adapted to changing requirements), portability (the ability to be easily modified for a new environment), reusability (the ability to be used in multiple applications), testability (the ability to be easily and thoroughly tested), usability (the ability to be easily learned and used), and other attributes.

No requirements have been identified.

3.12 Design and Implementation Constraints

Note: This section should include any requirements that constrain the design and implementation of TCS. Examples include: use of a particular architecture or requirements on the architecture, such as required databases or other software units; use of standard, military or existing components; or use of Government/acquired-furnished property (equipment, information or software); use of particular design or implementation standards; use of particular data standards; use of a particular programming language; flexibility and expandability that must be provided to support anticipated areas of growth or changes in technology, threat or mission.

Design and implementation will be accomplished in accordance with commercial best practices unless otherwise required to meet a specific service operational environmental factor.

Newly designed software will be developed in accordance with a tailored MIL-STD-498.

Consideration will be given to the reuse of software written for other systems where it is determined that the existing software is suitable for use with the TCS software.

A modular architecture will be used in order to support future interoperability with multiple types of UAVs while maintaining consistent displays and user interfaces and be robust enough to allow for the addition of future vehicle-specific modules.

The TCS software will be designed to provide a high degree of portability by being as independent of host hardware as possible while still achieving system operational requirements.

3.13 Human Performance/Human Engineering Requirements

Note: This section should include any TCS requirements included to accommodate the number, skill levels, duty cycles, training needs, or other information about the personnel who will use or support TCS. Examples include requirements for number of simultaneous users and for built-in help or training features. Also included shall be the human factors engineering requirements imposed on TCS. These requirements shall include, as applicable, considerations for the capabilities and limitations of humans; foreseeable human errors under both normal and extreme conditions; and specific areas where the effects of human error would be particularly serious. Examples include requirements for color and duration of error messages, physical placement of critical indicators or keys, and use of auditory signals.

During TCS laboratory testing, a TCS Operator, Interface Simulation Device (ISD) Operator and Test Personnel will be required.

TCS shall provide displays in a windowing environment. [SRS0050]

3.14 Training-related Requirements

Note: This section should include any TCS requirements pertaining to training. Examples include training software to be included in TCS.

No formal training programs are required during Software Build schedule. Trained and proficient personnel from the various involved contractor equipment manufacturers, government engineering teams and military service personnel will support the operation and maintenance of the TCS system equipment throughout TCS development.

3.15 Logistics-related Requirements

Note: This section should include an TCS requirements concerned with logistics considerations, including system maintenance, software support, system transportation modes, supply-system requirements, impact on existing facilities, and impact on existing equipment.

This section is not applicable to this version of the SRS.

3.16 Other Requirements

Note: This section should include any additional TCS requirements that were not covered in the previous sections.

No requirements have been identified.

3.17 Packaging Requirements

Note: This section should include any TCS requirements for packaging, labeling and handling TCS for delivery (for example, delivery on 9 track magnetic tape labeled and packaged in a certain way). Applicable military specifications and standards may be referenced if appropriate.

This section is not applicable to this SRS.

3.18 Precedence and Criticality of Requirements

All requirements in this document are considered to have equal weight regarding precedence and/or criticality.

There are no special requirements for safety or security applicable to this SRS.

Chapter 4 Qualification Provisions

This section defines a set of qualification methods and specifies for each requirement in Section 3 the method(s) to be used to ensure that the requirement has been met. Qualification methods may include:

Demonstration -- The operation of TCS or a part of TCS that relies on observable functional operation not requiring the use of instrumentation, special test equipment or subsequent analysis.

Test -- The operation of TCS or a part of TCS using instrumentation or other special test equipment to collect data for later analysis.

Analysis -- The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpretation, or extrapolation of test results.

Inspection -- The visual examination of TCS code, documentation, etc.

Special qualification methods -- Any special qualification methods for TCS, such as special tools, techniques, procedures, facilities and acceptance limits.

This section is not applicable to this version of the SRS, since the Software Builds (see Table C-1) are not undergoing Formal Qualification Test (FQT). Later versions of the SRS will include this information.

Chapter 5 Requirements Traceability

This section contains traceability from each TCS requirement in this SRS to the system requirement(s) it addresses and traceability from each system requirement allocated to TCS to the TCS requirement(s) that address it.

This traceability must be postponed until the SSS is published with system requirement IDs to use in the traceability.

Chapter 6 Acronym List

ADOCS	Automated Deep Operations Coordination System
AFATDS	Advanced Field Artillery Tactical Data System
API	Application Programming Interface
ASAS	All Source Analysis System
ATI	Artillery Target Intelligence
AV	Air Vehicle
CCTV	Closed Circuit Television
CDR	Coordinate Report
CGS	Common Ground Station
CHS-2	Common Hardware/Software - 2
C4I	Command, Control, Communications, Computers and Intelligence
DCM	Datalink Command Module
DII	Defense Information Infrastructure
EO/IR	Electro-Optic/Infra-Red
FC	Flight Control
FLIR	Forward Looking Infra-Red
FOV	Field of View
FQT	Formal Qualification Test
GMT	Greenwich Mean Time
GPS	Global Positioning System
GSM	Ground Station Module
IDD	Interface Design Description
ISD	Interface Simulation Device
JDISS	Joint Deployable Intelligence Support System
JII	Joint Interoperability Interface
JMCIS	Joint Maritime Command Information System
JPO	Joint Program Office
JSIPS-N	Joint Services Imagery Processing System - Navy
JSTARS	Joint Surveillance and Target Attack Radar System
MGRS	Military Grid Reference System
NITF	National Imagery Transmission Format
NTSC	National Television System Committee
ORD	Operational Requirements Document
PTW	Precision Targeting Workstation
RECCEXREP	Reconnaissance Exploitation Report
SALUTE	Size, Activity, Location, Unit, Time, and Equipment Report
SAR	Synthetic Aperture Radar
SBPCS	Submarine Based Predator Control System

SRS	Software Requirements Specification
SSS	System/Subsystem Specification
TAC-4	Tactical Advanced Computer - 4
TACCOM	Tactical Communication
TBD	To be determined
TCS	Tactical Control System
UAV	Unmanned Aerial Vehicle
UOC	Upon Operator Command
UTM	Universal Transverse Mercator
VCR	Video Cassette Recorder

Appendix A Algorithms

A.1 Mathematical Notation

Table A-1 Mathematical Notation

TERM	MEANING	EXAMPLE(s)
$div_x(y) = z$	integer division -- z equals the truncated integer result of y divided by x	$div_{365}(365) = 1$ $div_{365}(364) = 0$
$mod_x(y) = z$	modulo division -- z equals the integer remainder of y divided by x	$mod_{365}(365) = 0$ $mod_{365}(364) = 364$

A.2 Compute GMT_Hr, GMT_Min, GMT_Sec

Note: See A.1 for explanations and examples of mathematical terms used.

Input: GPS_Time_Sec = GPS time in seconds since 00:00:00 Sunday

Given: Sec_In_Day = 86,400
Sec_In_Hr = 3,600
Sec_In_Min = 60

Compute: GMT_Hr, GMT_Min, GMT_Sec

Algorithm:

$Sec\_In\_Current\_Day = mod_{Sec\_In\_Day}(GPS\_Time\_Sec)$

$Sec\_In\_Current\_Hr = mod_{Sec\_In\_Hr}(Sec\_In\_Current\_Day)$

$GMT\_Hr = div_{Sec\_In\_Hr}(Sec\_In\_Current\_Day)$

$GMT\_Min = div_{Sec\_In\_Min}(Sec\_In\_Current\_Hr)$

$GMT\_Sec = mod_{Sec\_In\_Min}(Sec\_In\_Current\_Hr)$

A.3 Compute GMT_Month, GMT_Day, GMT_Year

Notes: (1) See A.1 for explanations and examples of mathematical terms used.
(2) This algorithm will work only until 31 Dec. 2099 because century years that are not divisible by 400 are not leap years.

Input: GPS_Time_Wk = GPS time in weeks where week zero begins 00:00:00 Jan. 6, 1980
GPS_Time_Sec = GPS time in seconds since 00:00:00 Sunday

Given: Current_Day_Adjuster = 1
Current_Year_Adjuster = 1
Current_Leap_Year = 1
Days_In_Four_Years = 1,461
Days_In_Leap_Year = 366
Days_In_Regular_Year = 365
Days_In_Week = 7
First_Five_Days_In_1980 = 5
Four_Years = 4
Sec_In_Day = 86,400

Compute: GMT_Month, GMT_Day, GMT_Year

Algorithm:

$$\text{Complete\_Days\_Since\_1979} = \text{GPS\_Time\_Wk} * \text{Days\_In\_Week} + \text{First\_Five\_Days\_In\_1980} + \text{div}_{\text{Sec\_In\_Day}}(\text{GPS\_Time\_Sec})$$

$$\text{Complete\_Days\_In\_Current\_Four\_Years} = \text{mod}_{\text{Days\_In\_Four\_Years}}(\text{Complete\_Days\_Since\_1979})$$

if Complete_Days_In_Current_Four_Years < Days_In_Leap_Year, then

Leap_Year = True

$$\text{Days\_In\_Current\_Year} = \text{Complete\_Days\_In\_Current\_Four\_Years} + \text{Current\_Day\_Adjuster}$$

$$\text{Years\_Since\_1979} = \text{Four\_Years} * \text{div}_{\text{Days\_In\_Four\_Years}}(\text{Complete\_Days\_Since\_1979}) + \text{Current\_Year\_Adjuster}$$

else

Leap_Year = False

Days_In_Current_Year = $mod_{Days\_In\_Regular\_Year}$(Complete_Days_In_Current_Four_Years - Days_In_Leap_Year) + Current_Day_Adjuster

Years_Since_1979 = Four_Years * $div_{Days\_In\_Four\_Years}$(Complete_Days_Since_1979) + $div_{Days\_In\_Regular\_Year}$(Complete_Days_In_Current_Four_Years - Days_In_Leap_Year) + Current_Leap_Year + Current_Year_Adjuster

end if

if Leap_Year = True, then
    Feb_Days = 29

else
    Feb_Days = 28

end if

if Days_In_Current_Year ≤ 31, then
    GMT_Month = Jan
    GMT_Day = Days_In_Current_Year

elseif Days_In_Current_Year ≤ Feb_Days + 31, then
    GMT_Month = Feb
    GMT_Day = Days_In_Current_Year - 31

elseif Days_In_Current_Year ≤ Feb_Days + 62, then
    GMT_Month = Mar
    GMT_Day = Days_In_Current_Year - (Feb_Days + 31)

elseif Days_In_Current_Year ≤ Feb_Days + 92, then
    GMT_Month = Apr
    GMT_Day = Days_In_Current_Year - (Feb_Days + 62)

elseif Days_In_Current_Year ≤ Feb_Days + 123, then
    GMT_Month = May
    GMT_Day = Days_In_Current_Year - (Feb_Days + 92)

elseif Days_In_Current_Year ≤ Feb_Days + 153, then
    GMT_Month = Jun
    GMT_Day = Days_In_Current_Year - (Feb_Days + 123)

elseif Days_In_Current_Year ≤ Feb_Days + 184, then

GMT_Month = Jul
GMT_Day = Days_In_Current_Year - (Feb_Days + 153)

elseif Days_In_Current_Year ≤ Feb_Days + 215, then
GMT_Month = Aug
GMT_Day = Days_In_Current_Year - (Feb_Days + 184)

elseif Days_In_Current_Year ≤ Feb_Days + 245, then
GMT_Month = Sep
GMT_Day = Days_In_Current_Year - (Feb_Days + 215)

elseif Days_In_Current_Year ≤ Feb_Days + 276, then
GMT_Month = Oct
GMT_Day = Days_In_Current_Year - (Feb_Days + 245)

elseif Days_In_Current_Year ≤ Feb_Days + 306, then
GMT_Month = Nov
GMT_Day = Days_In_Current_Year - (Feb_Days + 276)

else
GMT_Month = Dec
GMT_Day = Days_In_Current_Year - (Feb_Days + 306)

end if

GMT_Year = 1979 + Years_Since_1979

A.4 Determine IR_Pyld_Zoom

Note: See A.1 for explanations and examples of mathematical terms used.

Input: IR_FOV where IR_FOV equals 14, 27, 54, 109, 193, 386

Determine: IR_Pyld_Zoom

Algorithm:

if IR_FOV = 14 then
IR_Pyld_Zoom = 560 mm
elseif IR_FOV = 27 then
IR_Pyld_Zoom = 280 mm
elseif IR_FOV = 54 then

```
        IR_Pyld_Zoom = 140 mm
elseif IR_FOV = 109 then
        IR_Pyld_Zoom = 70 mm
elseif IR_FOV = 193 then
        IR_Pyld_Zoom = 38 mm
else (IR_FOV = 386)
        IR_Pyld_Zoom = 19 mm
endif
```

A.5 Increment Target_Number

Input: Target_Number where Target_Number equals 6 printable characters, the first two characters represent the TCS Address and the last four characters represent a sequential target numbering scheme.

Define: Target_Number_Address = First Two Target_Number Characters
Target_Number_Number = Last Four Target_Number Characters

Given: Target_Number_Max_Number = 9999

Determine: Target_Number + 1

Algorithm:

```
if Int Target_Number_Number = Int Target_Number_Max_Number then
        Int Target_Number_Number = 1

else
        Int Target_Number_Number = Int Target_Number_Number + 1

endif

/* Check for leading zeros */

if Int Target_Number_Number < 10 then
        Char Target_Number_Number = “000” + Char (Int Target_Number_Number)

elseif Int Target_Number_Number < 100 then
        Char Target_Number_Number = “00” + Char (Int Target_Number_Number)

elseif Int Target_Number_Number < 1000 then
```

Char Target_Number_Number = “0” + Char (Int Target_Number_Number)

else

Char Target_Number_Number = Char (Int Target_Number_Number)

endif

Target_Number = Target_Number_Address + Char Target_Number_Number

A.6 Determine Placement of True North Pointing Arrow

A.6.1 Rotation Matrices

1. The convention for obtaining the air vehicle frame of reference is a yaw, pitch, roll, convention. This frame is aligned so that x is forward, y is starboard, and z is down from the air vehicle. For the first rotation, nose right is positive yaw, for the second rotation, nose up is positive pitch, and for the third rotation, right wing down, is positive roll.

2. The cartesian coordinate frame used in the computations is a "North-East-Down" frame. This frame is not defined at a latitude of +/- 90.0 degrees. (North/South Pole). Consequently, some computations will yield indefinite results if the UAV and/or the line of sight is at one of the poles.

3 The EO/IR payload bearing angle is measured in a clockwise direction from True North. For convenience this bearing angle is converted to a bearing angle measured in a clockwise direction from the AV centerline. The EO/IR payload depression angle is measured down from the AV x-y plane.

4. The air vehicle body to EO/IR camera frame rotation matrix includes for the first rotation, camera bearing, for the second rotation, camera depression, and for the third rotation, a 90^{o} rotation about the line-of-sight axis (x-axis) to preserve a positive y-z plane orientation on the image (y-axis vertical and z-axis horizontal).

Input: AV_True_Heading = UAV Heading in degrees, True North
AV_Pitch_Angle = UAV Pitch Angle in degrees
AV_Roll_Angle = UAV Roll Angle in degrees
EOIR_Pointing_Azimuth = EO/IR Pointing Azimuth in degrees, referenced to north heading
EOIR_Pointing_Depression = EO/IR Pointing Depression in degrees, referenced to aircraft

Constants: Degrees_to_Radians = .1745329251994326E-01

Algorithm:

All input values in degrees must be converted to radians:

AV_True_Heading_Radians = AV_True_Heading * Degrees_to_Radians
AV_Pitch_Angle_Radians = AV_Pitch_Angle * Degrees_to_Radians
AV_Roll_Angle_Radians = AV_Roll_Angle * Degrees_to_Radians
EOIR_Pointing_Azimuth_Radians = EOIR_Pointing_Azimuth * Degrees_to_Radians
EOIR_Pointing_Depression_Radians = EOIR_Pointing_Depression * Degrees_to_Radians

Evaluate the sines and cosines of the angles:

S1 = sin(AV_True_Heading_Radians)
S2 = sin(AV_Pitch_Angle_Radians)
S3 = sin(AV_Roll_Angle_Radians)
S4 = sin(EOIR_Pointing_Azimuth_Radians - AV_True_Heading_Radians)
S5 = sin(EOIR_Pointing_Depression_Radians)
C1 = cos(AV_True_Heading_Radians)
C2 = cos(AV_Pitch_Angle_Radians)
C3 = cos(AV_Roll_Angle_Radians)
C4 = cos(EOIR_Pointing_Azimuth_Radians - AV_True_Heading_Radians)
C5 = cos(EOIR_Pointing_Depression_Radians)

Compute the necessary components of the North, East, Down to Body Frame Rotation Matrix:

$NED2BD_{1,1}$ = C1 * C2
$NED2BD_{2,1}$ = (C1 * S2 * S3) - (S1 * C3)
$NED2BD_{3,1}$ = (C1 * S2 * C3) + (S1 * S3)

Compute the necessary components of the Body to Camera Frame Rotation Matrix:

$BD2CM_{2,1}$ = C4 * S5
$BD2CM_{2,2}$ = S4 * S5
$BD2CM_{2,3}$ = -C5
$BD2CM_{3,1}$ = -S4
$BD2CM_{3,2}$ = C4

Compute the necessary components of the north east down to camera frame rotation matrix as the matrix product of the north east down to body frame rotation matrix and the body frame to camera frame rotation matrix.

$NED2CM_{2,1} = BD2CM_{2,1}*NED2BD_{1,1}+BD2CM_{2,2}*NED2BD_{2,1}+BD2CM_{2,3}*NED2BD_{3,1}$
$NED2CM_{3,1} = BD2CM_{3,1}*NED2BD_{1,1}+BD2CM_{3,2}*NED2BD_{2,1}$

A.6.2 True North Pointing Arrow

Note: (1) Assumes target is located at EO/IR payload Center Field of View.
(2) Assumes Cross Hair (Graphic) is placed at EO/IR payload Center Field of View on the video screen and consists of a vertical and horizontal axis.

Determine: Horizontal_Projection = Indicated North Position along the Horizontal Cross Hair, unitless (-1 to 1)
Vertical_Projection = Indicated North Position along the Vertical Cross Hair, unitless (-1 to 1)

Algorithm:

The two camera frame components of the north indicated vector can be determined:

Vertical_Projection = ($NED2CM_{2,1}$)
Horizontal_Projection = ($NED2CM_{3,1}$)

Appendix B External Interfaces to SRS Data Groups Relationships

B.1 Downlink Interface to SRS Data Groups Relationship

Tables B-1, B-2, and B-3 each list a set of variables used by TCS. Note: The Field Numbers in Tables B-1, B-2, and B-3 are taken from the UAV System Status message, the EO/IR System Status message, and the Flight Control Status message respectively found in the TCS to SBPCS IDD. Only those fields from the UAV System Status message, the EO/IR System Status message, and the Flight Control Status message needed for TCS are included in these tables.

Table B-1 UAV System Status Message

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
AV_Tail_Nbr	UAV Tail Number/ID	1 to 127	2
Mission_ID_Nbr	Mission ID Number	0 to 255 (0 = PPO Modified Mission)	3
AV_Position__Source	Source of UAV position data, Latitude and Longitude	0 = Primary data source (LN-100G INS/GPS) 1 = Secondary data source (Trimble GPS) 2 = Calculated (Predicted) UAV Location	9
AV_Lat_Deg	UAV Latitude	-90.000_000 to +90.000_000 degrees (X 1,000,000)	10
AV_Lon_Deg	UAV Longitude	-180.000_000 to +180.000_000 degrees (X 1,000,000)	11
AV_Alt_Ft_Msl	UAV Altitude, above mean sea level from barometric pressure	-3,000 to 60,000 feet	12
AV_True_Heading	UAV Heading, True North from magnetometer	0 to 359.99 degrees (X 100)	14

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
AV_Ground_Track_Deg	UAV Course, Ground Track	0 to 359.99 degrees (X 100)	15
AV_Next_Waypoint	Number of the waypoint the UAV is flying toward	1 to 999	18
AV_Indicated_Airspeed	UAV Indicated Airspeed	0 to 255 Knots	23
GPS_Time_Wk	Current GPS Reference Time	0 to 2^{31}-1 weeks (week zero is Jan. 6, 1980)	30
GPS_Time_Sec	Current GPS Reference Time	0 to 2^{31}-1 seconds (seconds since 00:00:00, Sunday)	31
AV_Active_Sensor	UAV Active Sensor	0 = Nose Camera 1 1 = EO 2 - Daylight 2 = FLIR 3 = EO 1 - Spotter 4 = SAR 5 = Spare 6 = Receiver 3 7 = UAV VCR	41

Table B-2 EO/IR System Status Message

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
EOIR_Pointing_Mode	EO/IR Pointing Mode	0 = Position Reference (Heading) 1 = Position Fixed 2 = Slew, Manual (Growth) 3 = Bright Spot (Growth)	7
EOIR_Pointing_Azimuth	EO/IR Pointing Azimuth (ref. to north heading)	-180.00 to +180.00 degrees (X 100)	8
EOIR_Pointing_Depression	EO/IR Pointing Depression (ref. to aircraft)	-90.00 to +120.00 degrees (X 1,000,000)	9
EOIR_Fixed_Pt_Lat	EO/IR Fixed Pointing Latitude, Center Point	-90.000_000 to +90.000_000 degrees (X 1,000,000)	10
EOIR_Fixed_Pt_Long	EO/IR Fixed Pointing Longitude, Center Point	-180.000_000 to +180.000_000 degrees (X 1,000,000)	11
EO2_Zoom_Setting	EO2 Zoom Setting, Payload #2 (Day TV)	0 to 100 Percent 0 = Narrow field of view (2.3 deg(h) X 1.7 deg(v)) 100 = Wide field of view (21.8 deg(h) X 16.7 deg(v))	17

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
IR_FOV	IR FOV	1.4 to 38.6 degrees (X 10) 1.4 degree FOV = 560mm focal length, 2.7 degree FOV = 280mm focal length, 5.4 degree FOV = 140mm focal length, 10.9 degree FOV = 70mm focal length, 19.3 degree FOV = 38mm focal length, 38.6 degree FOV = 19mm focal length.	21
EOIR_Target_LOS_Distance	Slant Range, calculated distance to target viewed from EO/IR payload. Calculated using UAV position, camera pointing, and DTED data.	0.0 to 6553.5 nautical miles (X 10)	26

Table B-3 Flight Control Status Message

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
AV_Roll_Angle	Roll Angle from vertical gyro	-60.00 to 60.00 degrees (X 100)	3
AV_Pitch_Angle	Pitch Angle from vertical gyro	-60.00 to 60.00 degrees (X 100)	4
AV_Yaw_Rate	Yaw Rate from yaw rate gyro	-30.00 to 30.00 degrees per second (X 100)	5

AV_EOIR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
AV_Vertical_Speed	Vertical Speed from Barometric altitude	-3000 to 3000 feet per minute	6
AV_Normal_Accel	Acceleration, along Z axis, from normal accelerometer	-5.08 to 5.08 g (X 100)	7

B.2 TACCOM Interface to SRS Data Group Relationships

Table B-4 lists the allowable sets of variables associated with the Target_Type and Target_Subtype for ATI;CDR messages.

Table B-4 ATI;CDR Target Types and Subtypes

Target_Type	Target_Subtype	Target_Type	Target_Subtype	Target_Type	Target_Subtype
ADA	UNK	BRIDGE	UNK	PERS	UNK
	LT		FTPON		INF
	MDM		VEHPON		OP
	HV		CONC		POS
	MSL		WOOD		PTL
	POS		STEEL		WKPTY
			SITE		
			RAFT	RKTMSL	UNK
			FERRY		APERS
					MDMMSL
ARMOR	UNK	CEN	UNK		HVMSL
	LT		SMALL		ATANK
	MDM		BN		POS
	HV		REGT		
	APC		DIV	SUPPLY	UNK
	POS		FWD		AMMO
					PTL
ARTY	UNK	EQUIP	UNK		BRGEQ
	LT		RADAR		CLI
	MDM		EW		CLII
	HV		SLT		
	POS		GDNC	TER	UNK
			LS		ROAD
					JCT
ASSY	UNK	FORM	AGBBTR		HILL
	TRP		AGBBMP		DEFILE
	TRPVEH		AGBTKR		LDGSTR
	TRPMEC		MRBMNR		RR

Target_Type	Target_Subtype	Target_Type	Target_Subtype	Target_Type	Target_Subtype
	TRPARM		MRBSPR		
	TACBTR		MRBMNP	VEH	UNK
	ADMBTR		MRBSPP		LTWHL
	TACBMP		TNKBNM		HVWHL
	ADMBMP		TNKBNS		RECON
	TNKBNT				BT
	TNKBNA				ACFT
	SPRTEL				HEL
BLDG	UNK	MORT	UNK	WPN	UNK
	WOOD		LT		LTMG
	MASNRY		MDM		ATG
	CONC		HV		HVMG
	MET		VH		RCLR
			POS		POS

B.3 SAR Related Telemetry Data

Table B-5 shows the telemetry data inserted as text into the NITF_WITH_TEXT_MSG by the SAR Processor.

Table B-5 SAR Image Auxiliary Data File

AV_SAR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
AV_Tail_Nbr	UAV Tail Number/ID	1 to 127	1
AV_Lat_Deg	UAV Latitude	-90.000_000 to +90.000_000 degrees	2
AV_Lon_Deg	UAV Longitude	-180.000_000 to +180.000_000 degrees	3
AV_True_Heading	UAV Heading, True North from magnetometer	0 to 359.99 degrees	4
AV_Alt_Ft_Msl	UAV Altitude, mean above sea level from barometric pressure	-3,000 to 60,000 feet	5
Mission_ID_Nbr	Mission ID Number	0 to 255 (0 = PPO Modified Mission)	6

AV_SAR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
SAR_Image_Time	Time of Image	GMT, 00:00:00 to 23:59:59	7
SAR_Image_Date	Date of Image	GMT, dd MMM yy	8
SAR_ID	Sensor ID		9
SAR_Image_Azimuth	Scene Azimuth, center point, (ref. to true north)	0 to 359.99 degrees	10
SAR_Illumination_Angle	Scene Illumination Angle (direction of radiation)		11
SAR_Depression_Angle	Sensor Depression Angle (relative to horizon)	-90.00 to 120.00 degrees (below horizon is negative)	12
SAR_Slant_Range	Slant Range to Target	0 to 999999 ft	13
SAR_Image_Baseline_Length	Image Baseline Length (width of image at scene center line)	0 to 99999 ft	14
SAR_Sensor_Mode	SAR Sensor Mode		15
SAR_Center_Pt_Lat	Latitude of scene center point	-90.000_000 to +90.000_000 degrees	16
SAR_Center_Pt_Long	Longitude of scene center point	-180.000_000 to +180.000_000 degrees	17
SAR_LT_Pt_Lat	Latitude of scene left top corner	-90.000_000 to +90.000_000 degrees	18
SAR_LT_Pt_Long	Longitude of scene left top corner	-180.000_000 to +180.000_000 degrees	19
SAR_RT_Pt_Lat	Latitude of scene right top corner	-90.000_000 to +90.000_000 degrees	20

AV_SAR_TELEMETRY VARIABLE	DATA ITEM DESCRIPTION	RANGE ACROSS EXTERNAL INTERFACE	FIELD NBR
SAR_RT_Pt_Long	Longitude of scene right top corner	-180.000_000 to +180.000_000 degrees	21
SAR_RB_Pt_Lat	Latitude of scene right bottom corner	-90.000_000 to +90.000_000 degrees	22
SAR_RB_Pt_Long	Longitude of scene right bottom corner	-180.000_000 to +180.000_000 degrees	23
SAR_LB_Pt_Lat	Latitude of scene left bottom corner	-90.000_000 to +90.000_000 degrees	24
SAR_LB_Pt_Long	Longitude of scene left bottom corner	-180.000_000 to +180.000_000 degrees	25

Appendix C Requirement Scheduling

C.1 Requirement Schedule

Table C-1 attempts to define when and if a requirement will be supported by TCS relative to the Software Build schedule.

Table C-1 Requirements Schedule

1.0	1.0.1	Requirement Synopsis	Section
✓	✓	SRS0001. Upon Operator Command (UOC), load software into memory.	3.2.1
✓	✓	SRS0002. Commence operations using default state data.	3.2.1
✓	✓	SRS0003. If software load fails, terminate load operations.	3.2.1
✓	✓	SRS0004. UOC, initiate shutdown.	3.2.1
		SRS0005. Receive NITF 2.0 digital format file from Secondary Source.	3.2.2
✓	✓	SRS0006. Receive AV and payload telemetry data from SBPCS.	3.2.2
✓	✓	SRS0007. Convert AV and payload telemetry data into the TCS AV_EOIR_TELEMETRY data.	3.2.2
✓	✓	SRS0008. Receive RS-170 NTSC Video.	3.2.2
		SRS0009. Convert GPS_Time_Sec to GMT_Hr, GMT_Min, and GMT_Sec for use in video overlay.	3.2.3
		SRS0010. Convert GPS_Time_Wk to GMT_Month, GMT_Day, and GMT_Year for use in video overlay.	3.2.3
		SRS0011. If active sensor is FLIR determine correct zoom factor for use in video overlay.	3.2.3
		SRS0012. Overlay the RS-170 NTSC video imagery with data.	3.2.3
		SRS0013. UOC, display (or remove from display) video imagery with overlay on the TCS Video Screen.	3.2.3
✓	✓	SRS0014. UOC, display (or remove from display) video imagery without overlay on the TCS Video Screen.	3.2.3

1.0	1.0.1	Requirement Synopsis	Section
		SRS0015. Transmit video imagery with overlay to JMCIS.	3.2.3
		SRS0016. Transmit video imagery without overlay to JMCIS.	3.2.3
		SRS0017. Transmit video imagery with overlay to CCTV.	3.2.3
		SRS0018. Transmit video imagery without overlay to CCTV.	3.2.3
		SRS0019. Transmit video imagery with overlay to JSTARS-CGS.	3.2.3
		SRS0020. Transmit video imagery without overlay to JSTARS-CGS.	3.2.3
✓	✓	SRS0021. UOC, Display (or remove from display) a map, with a north upward orientation.	3.2.4
✓	✓	SRS0022. Provide map functionalities (e.g., pan, zoom).	3.2.4
✓	✓	SRS0023. Display icon on map, with associated tail number, indicating AV position and true heading.	3.2.4
✓	✓	SRS0024. Textually display AV position (lat/long, UTM, or MGRS), airspeed, altitude, and true heading.	3.2.4
✓	✓	SRS0025. UOC and simultaneous with requirement 26, capture a snapshot of imagery, up to once per second.	3.2.5.1
✓	✓	SRS0026. UOC and simultaneous with requirement 25, capture a snapshot of telemetry, up to once per second.	3.2.5.1
✓	✓	SRS0027. UOC, convert image snapshot of requirement 25 to NITF message format.	3.2.5.3
✓	✓	SRS0028. Incorporate an ASCII copy of the telemetry snapshot of requirement 26 into the NITF message.	3.2.5.3
✓	✓	SRS0029. UOC, incorporate operator entered ASCII text into the NITF message.	3.2.5.3
		SRS0030. UOC, transmit the NITF 2.0 digital format file received from secondary source to JDISS.	3.2.5.3
✓	✓	SRS0031. UOC, transmit a TCS developed NITF message to JDISS.	3.2.5.3
		SRS0032. UOC, transmit the NITF 2.0 digital format file received from secondary source to JSIPS-N/PTW.	3.2.5.3
✓	✓	SRS0033. UOC, transmit a TCS developed NITF message to JSIPS-N/PTW.	3.2.5.3
✓		SRS0034. UOC, capture the targeting data; convert GPS_Time_Sec to GMT_Hr, GMT_Min, GMT_Sec.	3.2.6.1

1.0	1.0.1	Requirement Synopsis	Section
✓		SRS0035. TCS capability of reading the TACCOM_CONFIG_FILE.	3.2.6.2
✓		SRS0036. For RECCEXREP, display the targeting data.	3.2.6.3
✓		SRS0037. Operator entry of RECCEXREP specific data.	3.2.6.3
✓		SRS0038. UOC, create a RECCEXREP message including targeting data and operator entries.	3.2.6.3
✓		SRS0039. UOC, transmit a RECCEXREP message to ASAS.	3.2.6.3
✓		SRS0040. For ATI;CDR, display the targeting data.	3.2.6.5
✓		SRS0041. Operator entry of ATI;CDR specific data.	3.2.6.5
✓		SRS0042. UOC, create an ATI;CDR message including targeting data and operator entries.	3.2.6.5
✓		SRS0043. UOC, transmit an ATI;CDR message to ADOCS.	3.2.6.5
		SRS0044. UOC, transmit an ATI;CDR message to AFATDS.	3.2.6.5
✓		SRS0045. Upon transmitting the ATI;CDR message, increment the Target Number by one (1).	3.2.6.5
		SRS0046. Create a JSTARS message.	3.2.7
		SRS0047. Transmit a JSTARS message to JSTARS-CGS.	3.2.7
✓	✓	SRS0048. TCS software hostable on Sun SPARC (CHS-2) workstation.	3.10.1
✓	✓	SRS0049. TCS software hostable on Hewlett-Packard TAC-4 workstation.	3.10.1
✓	✓	SRS0050. Provide displays in windowing environment.	3.13
✓		SRS0051. For SALUTE, display the targeting data.	3.2.6.4
✓		SRS0052. Operator entry of SALUTE specific data.	3.2.6.4
✓		SRS0053. UOC, create a SALUTE message including targeting data and operator entries.	3.2.6.4
✓		SRS0054. UOC, transmit a SALUTE message to ASAS.	3.2.6.4

1.0	1.0.1	Requirement Synopsis	Section
✓		SRS0055. UOC, transmit a TCS developed NITF message to ASAS.	3.2.5.3
✓	✓	SRS0056. Textually display the Center Field Of View (FOV) associated with the displayed Sky Ball video.	3.2.3
	✓	SRS0057. UOC, open a UNIX Window, log onto SAR Processor, and launch SAR Processing.	3.2.5.2
	✓	SRS0058. Use SAR Processor windowing functionality to capture SAR imagery and telemetry data, generate a NITF_WITH_TEXT_MSG, and copy the NITF_WITH_TEXT_MSG to a TCS local directory.	3.2.5.2
✓		SRS0059. Upon assigning (operator entry or incrementing) a new Target_Number, TCS shall save this Target_Number as the new Target_Number default value.	3.2.6.5
		SRS0060. UOC, transmit the NITF 2.0 digital format file received from secondary source to ASAS.	3.2.5.3